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THE USE OF α -ECDYSONE
TO BREAK PERMANENT DIAPAUSE
OF FEMALE HYBRIDS BETWEEN
PAPILIO GLAUCUS L. FEMALE AND
PAPILIO RUTULUS LUCAS MALE

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PREVIOUSLY WE HAVE SHOWN that both males and females can be produced by the cross female *P. rutulus* X male *P. glaucus* (Clarke and Sheppard, 1955) but the reciprocal cross only produces males, the females remaining in permanent diapause until they die.

In order to examine the phenotype of the F1 females for genetic purposes we attempted to use ecdysone (Clarke, Sheppard and Willig, 1972) in order to get the female adults to eclose. Although a number started to develop only one was sufficiently advanced to score the phenotype, and that did not emerge. The present paper reports the successful use of α -ecdysone and describes the phenotype of the F1 females when the female *glaucus* parent was the black form.

METHOD

α -Ecdysone was purchased from Simes, Milan. The hormone was dissolved in ethanol and diluted with distilled water to give a final concentration of 7.0 $\mu\text{g/ml}$ in 10% ethanol-water. The pupae (1.4 g) were injected with 20 μl each of this solution (100 ng α -ecdysone/g w.w) through the intersegmental membrane of the abdomen, avoiding piercing the pupal gut, nervous system or spiracles. The injections were repeated every second day, each pupa receiving six in all. The butterflies emerged 24 days after the first injection.

RESULTS

Two female insects which were similar to one another were

produced from the two pupae injected. It will be seen from the plate (bottom right) that they are intermediate between the black and yellow forms in that the normal yellow pattern is present but heavily suffused with black scales. The suffusion is almost complete in a triangular area at the base of the forewing, extending out as far as the proximal black bar in normal yellow *rutulus*. A corresponding black area is to be found in the hindwing extending from the inner margin to the proximal black line running through the cell towards the anal angle.

A similar female, together with a number of others showing less yellow, right through to black *glaucus*, was obtained by back crossing males of the F_1 to black *glaucus*.

On the ventral surface the F_1 females are also suffused with black but to a much lesser degree, so that the general appearance is rather like a sooty yellow form.

DISCUSSION

The use of α -ecdysone opens up the possibility of studying the genetics of species differences. In the case of the present cross this seems particularly likely as the F_1 hybrid females had their full complement of developed ova.

The black and yellow female forms of *P. glaucus* are controlled by a locus on the Y chromosome, apparently associated with a cytological marker (Clarke, Sheppard and Mittwoch, 1976). The inheritance of the black form is therefore maternal since the female is the heterogametic sex. The presence of an intermediate F_1 , plus similar insects in the back cross using male hybrids, demonstrates conclusively that *rutulus* carries an autosomal or perhaps X-linked gene (or genes) which modifies the effect of the Y-linked allelomorph controlling black. This finding has interesting implications with respect to the evolution of the black form, which mimics *Battus philenor*. *P. rutulus*, although it flies with *B. philenor* in a number of places, including the coastal range of California, has never evolved a mimetic form. It seems possible that in the *rutulus* gene complex the Y-linked black allelomorph if it arose would be so suppressed (the F_{1s} having only half the *rutulus* gene complex) that it would not produce a phenotype sufficiently close to *Battus* to have any advantage.

With the new technique we hope to get a series of back crosses to *rutulus* to test this hypothesis.



TEXT FOR PLATE

Top left: *Papilio glaucus* female, black. Top right: *Papilio glaucus* female, yellow. Bottom left: *Papilio rutulus* male. Bottom right: F1 hybrid female, ex black *P. glaucus* female X male *P. rutulus*.

LITERATURE CITED

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